Nutrient recycling – from vision to practice

Nutrient losses to water need to be reduced. This can be accomplished by sustainable use of nutrients and by recycling the nutrients contained in organic side streams. Researchers propose specific actions to speed up the changes needed for better nutrient recycling in Finland.

In the 2010 Baltic Sea Action Summit, the Finnish Government committed to efficient measures to improve the state of the Archipelago Sea by 2020. In addition, the aim was to turn Finland into a model country in nutrient recycling.

To promote the utilisation of nutrients, the goal of the current Government Programme (*Finland, a land of solutions*) is to increase the recovery of nutrients, especially in areas that are sensitive with regard to the Baltic Sea and other water systems, so that **at least 50 per cent of the manure and municipal wastewater sludge will be covered by advanced processes by the year 2025.**

According to the report prepared by research institutions working on the field of natural resources and the environment (Marttinen et al., 2017), **the goals of the Finnish Government cannot be reached at the current pace**. This Policy Brief contains proposals made by researchers for actions to promote the recycling of phosphorus and nitrogen.

To enhance the recycling of nutrients, the processing of organic side streams must be boosted. Achieving the processing rate required, a remarkable change in the normative guidance of nutrient use is needed.

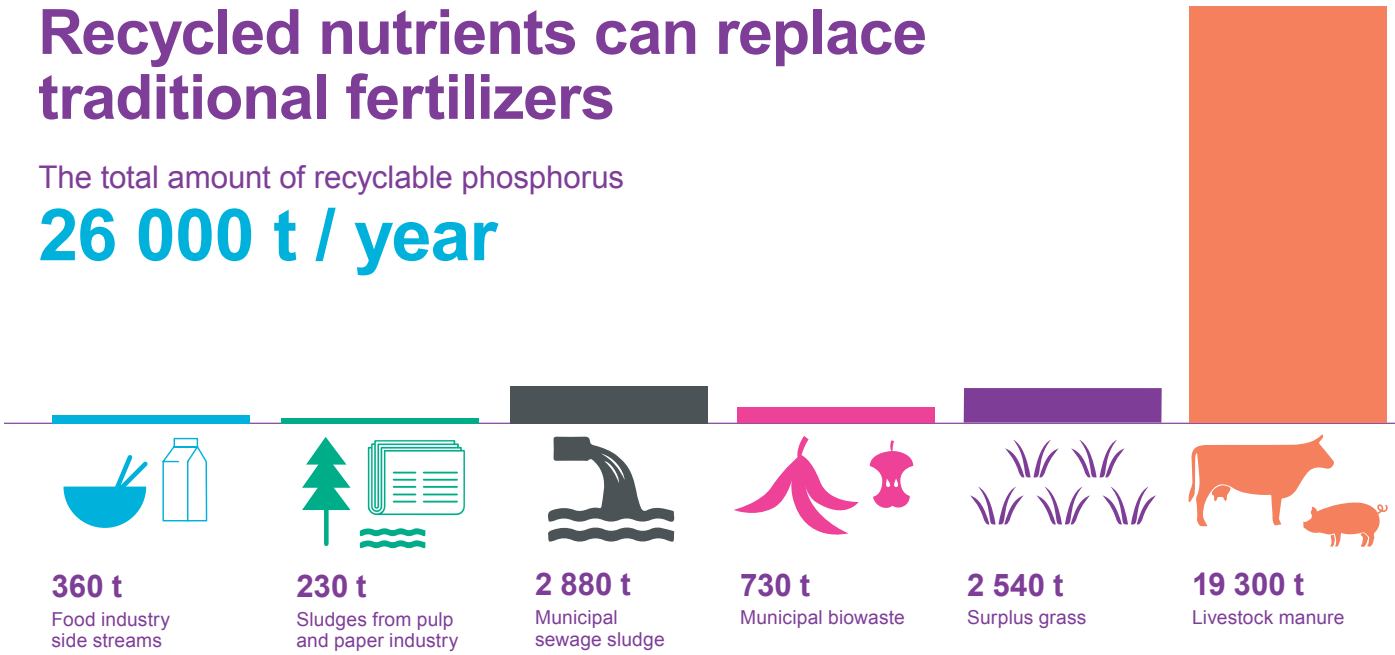
Read more:

Marttinen S., Venelampi O., Iho A., Koikkalainen K., Lehtonen E., Luostarinen S., Rasa K., Sarvi M., Tampio E., Turtola E., Ylivainio K., Grönroos J., Kauppila J., Koskiaho J., Valve H., Laine-Ylijoki J., Lantto R., Oasmaa A., zu Castell-Rüdenhausen M.: **Towards a breakthrough in nutrient recycling - State-of-the-art and recommendations for developing policy instruments in Finland**. Natural resources and bioeconomy studies, Luke 45/2017. In Finnish: http://jukuri.luke.fi/bitstream/handle/10024/540214/luke-luobio_45_2017.pdf?sequence=10

Recycled nutrients can replace traditional fertilizers

The total amount of recyclable phosphorus

26 000 t / year



360 t
Food industry side streams

230 t
Sludges from pulp and paper industry

2 880 t
Municipal sewage sludge

730 t
Municipal biowaste

2 540 t
Surplus grass

19 300 t
Livestock manure

26 000 t =

The portion of recyclable phosphorus would easily cover the amount needed for all of Finland's annual plant production.

>100%

The agricultural consumption of traditional inorganic phosphorus in 2015 was

11 000 t.

What is phosphorus?

Phosphorus is an element mined from the ground, used as a fertilizer to improve plant growth. Phosphorus becomes a problem when it flows into water bodies, where it causes algal blooms and increases eutrophication.

SOURCE Marttinen et al.: Towards a breakthrough in nutrient recycling – State-of-the-art and recommendations for developing policy instruments in Finland. Natural resources and bioeconomy studies, Luke 45/2017.

Recycling of nutrients means that the nutrients found in organic side streams are re-utilised sustainably and in a safe way in the form of recycled fertilisers or other products. In addition to nutrients, the organic matter in the side streams is valuable to the agricultural soil.

Waste and side streams generated annually in Finland contain 26,000 tons of phosphorus and 95,000 tons of nitrogen.

Even though **the amount of phosphorus suitable for recycling is higher than the demand of plants for fertilisers**, a total of 11,000 tons of artificial phosphorus-containing fertilisers was used in Finland in 2015.

Manure of domestic animals contains so much phosphorus that, if utilised efficiently, it would cover the phosphorus demand of cultivated plants in the whole of Finland.

Currently, nutrients contained in organic side streams are not recycled efficiently. This may cause **eutrophication, emissions to the air and dependency on inorganic fertilisers, the production of which is based on the use of non-renewable natural resources**.

There is a regional imbalance between the generation of manure and the need for nutrients. The areas with high animal production density produce excess volumes of phosphorus in relation to local demand.

The transportation of water-containing masses such as liquid manure, from one area to another is expensive.

The breakthrough of nutrient recycling requires processing of manure and other side streams so that nutrients can be transported and distributed better than at present. This means, for example, that the water content of these elements is reduced. Processing may also be needed to improve nutrient availability for plants.

AGRICULTURE PLAYS A KEY ROLE

In Finland, **of all industries, agriculture is the largest user of phosphorus and nitrogen**. Manure of domestic animals contains much higher amount of nutrients than other side streams.

The recycling of manure nutrients can be boosted through farm-specific measures, cooperation between farms and **by processing manure** in a way that makes it easier to transport over long distances. Currently 5 % of all manure in Finland is processed.

At least 20 % of all manure generated in Finland should be processed so that it can be transported over long distances across the regional boundaries in order to replace conventional inorganic phosphorus fertilisers.

The highest demand for advanced manure processing and transportation is in Ostrobothnia (approximately 60 %), Southern Ostrobothnia (30 %), Satakunta (25 %) and Southwest Finland (15 %).

PROCESSING OF MUNICIPAL SEWAGE SLUDGE NEEDS TO BE DEVELOPED FURTHER

Municipal sewage treatment plants generate sludge which contains the second highest amount of nutrients out of all organic side streams in Finland.

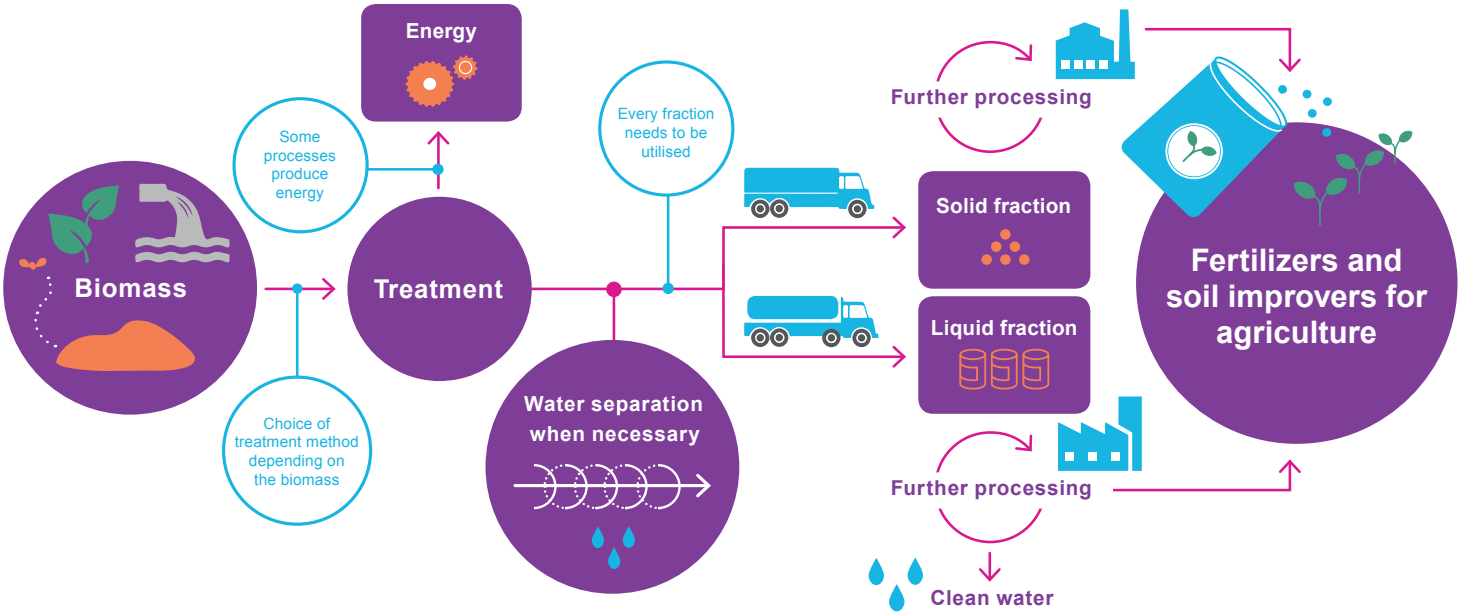
All sludge generated at treatment plants is processed but, according to the statistics, **only 3 % of all sludge is presently utilised in agriculture**.

Instead of the processing goal set for wastewater sludge in the Finnish Government Programme, **goals should be set for the re-utilisation of nutrients**.

Increasing the use of wastewater sludge in agriculture requires technological changes in wastewater treatment or sludge processing.

When using sewage sludge in agriculture, it must be ensured that the harmful substances contained in sludge do not present any safety risks or reduce the consumers' readiness to buy food which is produced using sewage sludge based fertilisers.

Processing facilitates nutrient utilisation



Read more:
Ylivainio K., Sarvi M., Lemola R., Uusitalo R., Turtola E.: **Regional P stocks in soil and in animal manure as compared to P requirement of plants in Finland**. Baltic Forum for Innovative Technologies for Sustainable Manure Management. WP4 Standardisation of manure types with focus on phosphorus. Natural Resources and bioeconomy studies 62/2015 https://jukuri.luke.fi/handle/10024/481761

TOTAL REFORM OF POLICY INSTRUMENTS TO BOOST THE RECYCLING OF NUTRIENTS

Currently, the use of nitrogen in agriculture in Finland is governed by legislation that implements the EU nitrate decree. The voluntary agri-environmental scheme limits the use of both, phosphorus and nitrogen. In addition, the fertiliser regulation and the environmental permits of animal production units guide the use of nutrients.

Promoting the sustainable use of nutrients requires changes in legal regulation. The Government's goal set for the recycling of nutrients requires the support of comprehensive legal standards focusing particularly on the use of phosphorus.

General legal standards should seek to adjust nutrient use so that it is in line with the requirements of the specific crops. Regulation must support the replacement of conventional inorganic fertilisers by recycled nutrients.

Currently, the use of nutrients is guided by a wide array of policy instruments that form **an incoherent and unorganised mix of regulations**. It would be clearer to define **a single statute covering all types of fertilisation**.

The nitrate decree provides a feasible basis for regulatory development. In Finland, the decree should define limits for the use of phosphorus as well, not only for nitrogen.

Enhancing nutrient recycling calls for policy coherence. In addition to legal regulation, investment subsidies are needed to give a boost to biomass processing.

Proposal: All legal standards related to fertilisation should be merged into a single statute. The current policy that controls nutrient use via the agri-environment-climate measures and environmental permits should be replaced by a comprehensive regulatory reform.

IT ALL COMES DOWN TO FACTS

The recycling of nutrients can only be planned and controlled efficiently if reliable and up-to-date information about factors critical to the recycling of nutrients is available.

There is a need for improvement in the collection of data, the compilation of statistics and the development of data systems regarding the volumes, sources and properties of organic side streams and ash.

There is also a need for coherent information concerning the phosphorus status of cultivated land.

In order to offer back-up to normative guidance and to help direct efficiently the measures of support, there is a need for developing a comprehensive data system on biomasses and a field plot specific database on nutrients.

BioSociety

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